

Serial No. 09/942,030

IN THE CLAIMS

1. (Currently amended) A gas flow meter comprising:

a gas flow detection circuit for detecting a current flowing through a resistor installed in a gas passage and a voltage generated across the resistor and outputting a voltage signal representing a gas flow passing through the gas passage;

a noise reduction circuit for reducing external noise induced in a power supply line for supplying electric power to said gas flow meter; and

a digital adjusting circuit for digitally adjusting a signal representing the detected gas flow and outputting the adjusted signal;

wherein said gas flow meter outputs a voltage signal based on the signal adjusted by the digital adjusting circuit.

2. (Currently amended) The gas flow meter according to claim 1, wherein said digital adjusting circuit includes:

a digital conversion circuit for converting an output from the gas flow detection circuit into a digital signal;

adjusting means for adjusting the digital signal to produce a desired output characteristic; and

a regulator circuit for supplying a reference voltage to the digital conversion circuit and/or the adjusting means;

Serial No. 09/942,030

and an integrated circuit substrate comprises said noise reduction circuit,
said digital adjusting circuit and said regulator circuit formed thereon.

3. (Original) A gas flow meter comprising:

a gas flow detection circuit for detecting a gas flow passing through a gas passage;

an adjusting circuit for adjusting an output characteristic of said gas flow meter to a desired output characteristic and outputting a gas flow signal; and
a noise reduction circuit including an overvoltage protection circuit and supplying to the gas flow detection circuit and the adjusting circuit a voltage whose surges and overvoltages applied to a power supply terminal are reduced;

wherein there are two or more voltage supply paths for supplying different voltages to the gas flow detection circuit and the adjusting circuit through the overvoltage protection circuit.

4. (Original) The gas flow meter according to claim 3, wherein in one of the voltage supply paths for supplying a voltage having reduced surges and overvoltages to various circuits, a voltage limiter circuit that turns on when applied with a voltage in excess of a predetermined voltage is connected between a voltage supply terminals and a ground terminal and a current limiting resistor is connected between the power supply terminal and the voltage supply terminals;

in the other voltage supply path, another current limiting resistor is connected between the power supply terminal and the voltage supply terminals;

Serial No. 09/942,080

and

an overvoltage protection circuit is provided in which a diode is connected between each of the voltage supply terminals.

5. (Original) The gas flow meter according to claim 3, wherein in all of said voltage supply paths for supplying a voltage having reduced surges and overvoltages to various circuits, a voltage limiter circuit that turns on when applied with a voltage in excess of a predetermined voltage is connected between voltage supply terminals and a ground terminal and a current limiting resistor is connected between the power supply terminal and the voltage supply terminals; and

an overvoltage protection circuit is provided in which the current limiting resistors connected to the respective voltage supply terminals have different resistance values.

6. (Original) The gas flow meter according to claim 4, further including an overvoltage protection circuit having an additional diode connected between the voltage supply terminals and the ground terminal.

7. (Original) The gas flow meter according to claim 5, further including an overvoltage protection circuit having an additional diode connected between the voltage supply terminals and the ground terminal.

8. (Original) The gas flow meter according to claim 3, wherein a part or all of devices included in said overvoltage protection circuit, said gas flow detection circuit and said adjusting circuit are formed in a common integrated circuit.

Serial No. 09/942,030

9. (Original) The gas flow meter according to claim 3, wherein two voltage supply paths are provided; and

a circuit connected to a higher supply voltage is an operational amplifier in the gas flow detection circuit and a circuit connected to a lower supply voltage is a regulator that supplies a voltage to the digital adjusting circuit.

10. (Original) The gas flow meter according to claim 4, wherein two voltage supply paths are provided; and

a circuit connected to a higher supply voltage is an operational amplifier in the gas flow detection circuit and a circuit connected to a lower supply voltage is a regulator that supplies a voltage to the digital adjusting circuit.

11. (Original) The gas flow meter according to claim 5, wherein two voltage supply paths are provided; and

a circuit connected to a higher supply voltage is an operational amplifier in the gas flow detection circuit and a circuit connected to a lower supply voltage is a regulator that supplies a voltage to the digital adjusting circuit.

12. (Original) The gas flow meter according to claim 6, wherein two voltage supply paths are provided; and

a circuit connected to a higher supply voltage is an operational amplifier in the gas flow detection circuit and a circuit connected to a lower supply voltage is a regulator that supplies a voltage to the digital adjusting circuit.

13. (Original) The gas flow meter according to claim 7, wherein two voltage

Serial No. 09/942,030

supply paths are provided; and

a circuit connected to a higher supply voltage is an operational amplifier in the gas flow detection circuit and a circuit connected to a lower supply voltage is a regulator that supplies a voltage to the digital adjusting circuit.

14. (Original) The gas flow meter according to claim 8, wherein two voltage supply paths are provided; and

a circuit connected to a higher supply voltage is an operational amplifier in the gas flow detection circuit and a circuit connected to a lower supply voltage is a regulator that supplies a voltage to the digital adjusting circuit.

15. (Currently amended) A gas flow meter comprising:

a gas flow detection circuit for outputting a voltage signal representing a gas flow passing through a gas passage; and

a conversion circuit for converting an output signal from said gas flow detection circuit into a digital signal; and

an adjusting circuit for adjusting the voltage output from the gas flow detection digital signal from said conversion circuit;

wherein an input range a level of the voltage digital signal entered inputted into the adjusting circuit is divided in two or more ranges and, in each divided range, a different an individual adjustment calculation formula is set in advance for the digital signal at each of the divided ranges, and;

wherein said gas flow meter further comprises: adjusting circuit further

Serial No. 09/942,030

comprising means for selecting the adjustment calculation formula according to an input value of the voltage signal entered the range of the digital signal inputted into the adjusting circuit and performing adjustment calculation by applying the selected formula to the inputted digital signal to produce an output value.

16. (Original) The gas flow meter according to claim 15, wherein the adjusting circuit is a digital adjusting circuit which digitally adjusts the signal representing the detected gas flow and outputs the adjusted signal.

17. (Original) The gas flow meter according to claim 15, wherein the adjusting circuit has input/output characteristics represented by each of the adjustment calculation formulas expressed as a first-degree function of $y = a \cdot x + b$ where x is an output value of the gas flow detection circuit, i.e., input value for the adjustment calculation, y is an output of the adjustment calculation, and a and b are adjustment coefficients.

18. (Original) The gas flow meter according to claim 16, wherein the adjusting circuit has input/output characteristics represented by each of the adjustment calculation formulas expressed as a first-degree function of $y = a \cdot x + b$ where x is an output value of the gas flow detection circuit, i.e., input value for the adjustment calculation, y is an output of the adjustment calculation, and a and b are adjustment coefficients.

19. (Original) The gas flow meter according to claim 15, further including:
a temperature sensor; and

Serial No. 09/942,030

a digital conversion circuit for converting an output of the temperature sensor into a digital value;
wherein said adjusting circuit also uses the output of the temperature sensor in performing the adjustment calculation.

20. (Original) The gas flow meter according to claim 16, further including:
a temperature sensor; and
a digital conversion circuit for converting an output of the temperature sensor into a digital value;
wherein said adjusting circuit also uses the output of the temperature sensor in performing the adjustment calculation.

21. (Original) The gas flow meter according to claim 17, further including:
a temperature sensor; and
a digital conversion circuit for converting an output of the temperature sensor into a digital value;
wherein said adjusting circuit also uses the output of the temperature sensor in performing the adjustment calculation.

22. (Original) The gas flow meter according to claim 18, further including:
a temperature sensor; and
a digital conversion circuit for converting an output of the temperature sensor into a digital value;
wherein said adjusting circuit also uses the output of the temperature sensor

Serial No. 09/942,030

in performing the adjustment calculation.

23. (Original) The gas flow meter according to claim 19, wherein said adjusting circuit has an input/output characteristic expressed by

$$y = (a1 \cdot t + a2) \cdot x + (b1 \cdot t + b2)$$

where x is an output value of the gas flow detection circuit, t is an output value of the temperature sensor, and a1, a2, b1 and b2 are adjustment coefficients.

24. (Original) The gas flow meter according to claim 16, wherein said adjusting circuit has an input/output characteristic expressed by

$$y = (a1 \cdot t + a2) \cdot x + (b1 \cdot t + b2)$$

where x is an output value of the gas flow detection circuit, t is an output value of the temperature sensor, and a1, a2, b1 and b2 are adjustment coefficients.

25. (Original) The gas flow meter according to claim 17, wherein said adjusting circuit has an input/output characteristic expressed by

$$y = (a1 \cdot t + a2) \cdot x + (b1 \cdot t + b2)$$

where x is an output value of the gas flow detection circuit, t is an output value of the temperature sensor, and a1, a2, b1 and b2 are adjustment coefficients.

26. (Original) The gas flow meter according to claim 18, wherein said adjusting circuit has an input/output characteristic expressed by

$$y = (a1 \cdot t + a2) \cdot x + (b1 \cdot t + b2)$$

where x is an output value of the gas flow detection circuit, t is an output value of the temperature sensor, and a1, a2, b1 and b2 are adjustment coefficients.

Serial No. 09/942,030

27. (Currently amended) The gas flow meter according to claim 17, wherein said adjusting circuit includes a programmable storage device ~~wherein~~ into which the adjustment coefficients a, a1, a2, b, b1 and b2 are written-~~into~~.

28. (Currently amended) The gas flow meter according to claim 17 or 13, wherein the adjusting circuit includes an erasable and programmable storage device ~~wherein~~ into which the adjustment coefficients a, a1, a2, b, b1 and b2 are written-~~into~~.

29. (Currently amended) The gas flow meter according to claim 18, wherein said adjusting circuit includes an erasable and programmable storage device ~~wherein~~ into which the adjustment coefficients a, a1, a2, b, b1 and b2 are written-~~into~~.

30. (Currently amended) The gas flow meter according to claim 19, wherein said adjusting circuit includes an erasable and programmable storage device ~~wherein~~ into which the adjustment coefficients a, a1, a2, b, b1 and b2 are written-~~into~~.

31. (Currently amended) The gas flow meter according to claim 20, wherein said adjusting circuit includes an erasable and programmable storage device ~~wherein~~ into which the adjustment coefficients a, a1, a2, b, b1 and b2 are written-~~into~~.

32. (Currently amended) The gas flow meter according to claim 21, wherein said adjusting circuit includes an erasable and programmable storage device ~~wherein~~ into which the adjustment coefficients a, a1, a2, b, b1 and b2 are written-~~into~~.

33. (Currently amended) The gas flow meter according to claim 22, wherein said adjusting circuit includes an erasable and programmable storage device ~~wherein~~

Serial No. 09/942,030

into which the adjustment coefficients a, a1, a2, b, b1 and b2 are written ~~into~~.

34. (Currently amended) The gas flow meter according to claim 23, wherein said adjusting circuit includes an erasable and programmable storage device ~~wherein~~ into which the adjustment coefficients a, a1, a2, b, b1 and b2 are written ~~into~~.

35. (Currently amended) The gas flow meter according to claim 24, wherein said adjusting circuit includes an erasable and programmable storage device ~~wherein~~ into which the adjustment coefficients a, a1, a2, b, b1 and b2 are written ~~into~~.

36. (Currently amended) The gas flow meter according to claim 25, wherein said adjusting circuit includes an erasable and programmable storage device ~~wherein~~ into which the adjustment coefficients a, a1, a2, b, b1 and b2 are written ~~into~~.

37. (Currently amended) The gas flow meter according to claim 26, wherein said adjusting circuit includes an erasable and programmable storage device ~~wherein~~ into which the adjustment coefficients a, a1, a2, b, b1 and b2 are written ~~into~~.

38. (Original) A gas flow meter comprising:

an adjusting circuit for adjusting a voltage output of a gas flow detection circuit which outputs a voltage signal representing a gas flow passing through a gas passage;

a storage device for storing data for adjustment; and

a data input/output circuit;

wherein said data input/output circuit has two external data communication terminals for writing adjust data from outside into said storage device and for

Serial No. 09/942,030

reading data from said storage device to the outside.

39. (Original) The gas flow meter according to claim 38, further comprising means which, after a predetermined number, two or more, of pulses have been supplied to one of the external data communication terminals of the data input/output circuit, allows the adjust circuit to enter into a data communication mode where it transfers data between the storage device and external circuits.

40. (Original) A gas flow meter comprising:

an adjusting circuit for adjusting a voltage output of a gas flow detection circuit which outputs a voltage signal representing a gas flow passing through a gas passage; and

a storage device for storing data for adjustment;
wherein said adjusting circuit retrieves as the output signal of the detected gas flow a ratiometric analog output, a non-ratiometric analog output and a digital output and selects one of these output signals by an output selection means provided in the adjusting circuit.

41. (Original) The gas flow meter according to claim 40, wherein said circuits for producing the ratiometric analog output, the non-ratiometric analog output and the digital output are formed on a same integrated circuit.

42. (Original) The gas flow meter according to claim 38, wherein the external data communication terminals serve as a detected flow output terminal.

43. (Currently amended) The gas flow meter according to claim 4039, wherein

Serial No. 09/942,030

the external data communication terminals serve as a detected flow output terminal.

44. (Original) A gas flow meter comprising:

a gas flow detection circuit for detecting a current flowing through a resistor installed in a gas passage and a generated voltage and outputting a voltage signal representing a gas flow passing through the gas passage;

a digital conversion circuit for converting the detected gas flow into a digital signal; and

a digital adjusting circuit for digitally adjusting the digital signal and outputting the adjusted digital signal;

wherein a voltage signal based on the digital signal adjusted by said digital adjusting circuit is output, and

the digital conversion circuit has means for selecting either a single-phase input or a differential input.

45. (Original) A gas flow meter comprising:

a gas flow detection circuit for detecting a current flowing through a resistor installed in a gas passage and a voltage generated across the resistor and outputting a voltage signal representing a gas flow passing through the gas passage;

a digital conversion circuit for converting the detected gas flow into a digital signal;

Serial No. 09/942,030

a digital adjusting circuit for digitally adjusting the digital signal and outputting the adjusted digital signal; and
an analog conversion circuit for receiving the adjusted digital signal and converting it into an analog signal;

wherein said analog conversion circuit is driven by a voltage based on an external reference voltage and a voltage follower circuit is arranged between a reference voltage terminal and a power supply terminal which drives said analog conversion circuit.

46. (New) The gas flow meter according to claim 1, wherein an integrated circuit substrate is provided and comprises said digital adjusting circuit and said regulator circuit formed thereon.